

Claims

What is claimed is

1. A device, comprising:

5 a fiber loop;

an optical coupler in said fiber loop to couple input light into said fiber loop as two counter-propagating waves in said loop and to couple light in said loop out as an output beam;

10 a polarization device in said fiber loop to change polarization of light in said loop to achieve a maximum power level and a minimum power level in said output beam;

an optical detector to receive said output beam to produce a detector signal; and

15 a circuit to process said detector signal to produce an output indicative of a signal-to-noise ratio or a degree of polarization in said input light from said maximum and minimum power levels.

20 2. The device as in claim 1, wherein said circuit controls said polarization device to systematically change said polarization to produce said maximum and said minimum power levels in said output beam.

3. The device as in claim 1, wherein said polarization device is a polarization scrambler which randomly changes said polarization.

5 4. The device as in claim 1, further comprising a tunable optical filter to filter said input light and direct filtered input light to said optical coupler for coupling into said fiber loop.

10 5. A device, comprising:

 a polarization scrambler to scramble polarization of received light to produce output light in a controlled manner in response to a control signal;

15 a polarizer to receive said output light from said polarization scrambler to produce a transmitted beam; an optical detector to receive said transmitted beam to produce a detector signal; and a control unit to produce said control signal to said polarization scrambler and to process said detector signal 20 to produce an output indicative of a signal-to-noise ratio or a degree of polarization in said input light.

6. The device as in claim 5, further comprising a tunable optical filter to filter said received light and

direct filtered light to said polarization scrambler.

7. A device, comprising:

a polarization device to adjust polarization of
5 received light to produce output light to find a maximum
power level and a minimum power level of each WDM channel
of different WDM channels in said received light;

a WDM demultiplexer to receive said output light and
to separate different WDM channels in said output light;

10 a plurality of polarizers in optical paths of said
different WDM channels, respectively;

a plurality of optical detectors to respectively
receive said different WDM channels after transmission
through said polarizers; and

15 a circuit to process output signals from said optical
detectors to produce an output for each WDM channel
indicative of a signal-to-noise ratio or a degree of
polarization in said each WDM channel from said maximum
power level and said minimum power level.

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8. The device as in claim 7, wherein said polarization
device is a polarization scrambler which randomly changes
said polarization in searching for said maximum power level
and said minimum power level.

9. The device as in claim 7, wherein said polarization device is a polarization controller.

5 10. A device, comprising:

a polarization device to scramble adjust polarization of received light to produce output light to find a maximum power level and a minimum power level of each WDM channel of different WDM channels in said received light;

10 a WDM demultiplexer to receive said output light to separate different WDM channels in said output light;

a polarizer in an optical path of said output light between said polarization device and said WDM demultiplexer to transmit said output light to said WDM demultiplexer;

15 a plurality of optical detectors to respectively receive said different WDM channels after transmission through said polarizers;

a circuit to process output signals from said optical detectors to produce an output for each WDM channel 20 indicative of a signal-to-noise ratio or a degree of polarization in said each WDM channel from said maximum power level and said minimum power level.

11. The device as in claim 10, wherein said

polarization device is a polarization scrambler which randomly changes said polarization in searching for said maximum power level and said minimum power level.

5 12. The device as in claim 10, wherein said polarization device is a polarization controller.

13. A device, comprising:

a polarization device to change polarization of
10 received light to produce output light to find a maximum power level and a minimum power level of each WDM channel of different WDM channels in said received light;

an optical polarizer to receive said output light to produce a beam;

15 an optical diffraction grating to diffract said beam into spatially separated different WDM channels;

a lens to transmit said different WDM channels;

a plurality of optical detectors to respectively receive said different WDM channels from said lens; and

20 a circuit to process output signals from said optical detectors to produce an output for each WDM channel indicative of a signal-to-noise ratio or a degree of polarization in said each WDM channel.

14. The device as in claim 13, wherein said polarization device is a polarization scrambler which randomly changes said polarization in searching for said maximum power level and said minimum power level.

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15. The device as in claim 13, wherein said polarization device is a polarization controller.

16. A device, comprising:

10 a polarization device to change polarization of received light to produce output light to find a maximum power level and a minimum power level of each WDM channel of different WDM channels in said received light;

15 a WDM demultiplexer to receive said output light to separate different WDM channels in said output light;

a plurality of polarization beam splitters in optical paths of said different WDM channels, respectively, wherein each polarization beam splitter splits a corresponding WDM channel into two monitor beams that are orthogonally polarized;

20 a plurality of filters disposed in one of said two monitor beams for said different WDM channels, respectively, each operable to produce a difference in power between noise power levels in said two monitor beams

for each WDM channel without affecting signal power levels in said each WDM channel in said two monitor beams;

 a plurality of pairs of optical detectors provided for different WDM channels, wherein two optical detectors in 5 each pair are positioned to respectively receive said two monitor beams for a corresponding WDM channel to produce two detector outputs for said WDM channel; and

 . a control unit to produce said control signal and to process detector signals to produce an output for each WDM 10 channel indicative of a signal-to-noise ratio or a degree of polarization in said each WDM channel.

17. The device as in claim 16, wherein said polarization device is a polarization scrambler which 15 randomly changes said polarization in searching for said maximum power level and said minimum power level.

18. The device as in claim 16, wherein said polarization device is a polarization controller.

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19. A device, comprising:
 a polarization device to change polarization of received light to produce output light to find a maximum power level and a minimum power level of each WDM channel

of different WDM channels in said received light;

 a polarization beam splitter to split said output light into first and second beams of orthogonal polarizations;

5 a first WDM demultiplexer to receive said first beam to separate different WDM channels in said first beam;

 a second WDM demultiplexer to receive said second beam to separate different WDM channels in said second beam, wherein said first WDM demultiplexer is different from from
10 said second WDM demultiplexer in way that a noise power level in an output WDM channel from said first WDM demultiplexer is different from a noise power level in the same WDM channel from said second WDM demultiplexer;

 a first set of optical detectors located to receive
15 different WDM channels from said first WDM demultiplexer;

 a second set of optical detectors located to receive different WDM channels from said second WDM demultiplexer;
and

 a control unit to produce said control signal and to
20 process detector signals from said first set and said second set of optical detectors to produce an output for each WDM channel indicative of a signal-to-noise ratio or a degree of polarization in said each WDM channel.

20. The device as in claim 19, wherein said polarization device is a polarization scrambler which randomly changes said polarization in searching for said maximum power level and said minimum power level.

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21. The device as in claim 19, wherein said polarization device is a polarization controller.

22. A device, comprising:

10 a polarization element operable to adjust optical polarization of input light;

a polarizer to receive light from said polarization element to produce a transmitted beam;

15 an optical detector to receive said transmitted beam from said polarizer; and

a signal processing circuit to process output of said optical detector to extract information on a state of polarization of said input light.

20 23. The device as in claim 22, wherein said polarization element is a polarization controller.

24. The device as in claim 22, wherein said polarization element is a rotatable quarter-wave plate.

25. The device as in claim 22, wherein said polarization element is a state-of-polarization generator.

5 26. The device as in claim 22, wherein said polarization element comprises:

first and second polarization rotators sequentially positioned in an optical path;

10 a quarter waveplate in said optical path to receive output light from said first and said second polarization rotators; and

15 third and fourth polarization rotators sequentially positioned in said optical path to receive output light from said quarter waveplate, wherein each polarization rotator is adjustable in response to a control signal.

27. The device as in claim 26, wherein said polarization element further comprises an input optical polarizer in said optical path in front of said first and 20 said second polarization rotators.

28. The device as in claim 26, wherein each polarization rotator is a magneto-optic (MO) rotator.

29. The device as in claim 26, wherein each rotator is responsive to a first control signal to rotate the polarization by $+22.5^\circ$, and responsive to a second control signal to rotate the polarization by -22.5° , wherein said 5 first and said second rotators are rotated in the same direction to produce a net rotation of 45° , and said third and said fourth rotators are rotated in the same direction to produce a net rotation of 45° , and wherein said first and said second rotators are rotated in the opposite 10 directions to produce a net rotation of 0° , and said third and said fourth rotators are rotated in the opposite directions to produce a net rotation of 0° .

30. A method, comprising:

15 obtaining a monitor beam from a fiber line carrying WDM channels;

spatially separating WDM channels from said monitor beam;

20 separating each WDM channel into a first beam and a second beam with orthogonal polarizations in a way that noise power level in said first beam is different from a noise power level in said second beam;

adjusting polarization of each WDM channel prior to separation into said first and said second beams to find a

maximum power level and a minimum power level in each of said first and said second beams; and determining both a signal-to-noise ratio and a degree of polarization of each WDM channel in said monitor beam.